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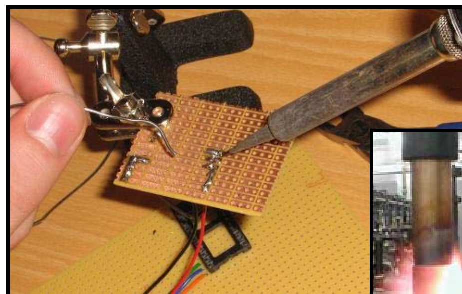
|---|---|
| **BROOKHAVEN NATIONAL LABORATORY**<br>Safety & Health Services Division<br><br>**INDUSTRIAL HYGIENE GROUP**<br>Standard Operating Procedure: Field Procedure | NUMBER<br>**IH75250**<br><br>REVISION<br>**FINAL Rev0** |
| **Soldering & Brazing Operation's Airborne Hazards Evaluations** | DATE<br>**09/18/07**<br><br>PAGE<br>**1** OF14 |

## Contents





## 1.0 Purpose & Scope

This document describes a field procedure for measuring airborne hazards from soldering and brazing operations. Part of a complete evaluation of hazards from soldering and brazing operations includes measurements of surface levels of hazardous metals, which is to be done via IH75190.

The purpose of the procedure is to provide a uniform methodology to collect representative samples of airborne particulates of metals and thermal decomposition fumes. This method is appropriate for collection of metal particulates and the colophony fumes from the heating of acid and rosin based fluxes. Using this method will ensure repeatability between various sampling personnel and ensure consistent evaluations among soldering operation configurations.

## 2.0 Responsibilities

2.1 **Demonstrated Competency:** This procedure is administered through the SHSD Industrial Hygiene Group. It is implemented through members of the SHSD Industrial Hygiene Group, the Radiological Control Division Facility Support Group, and other BNL ESH&Q related organizations. Only persons who have demonstrated competency in performing this procedure in accordance with Section 7 are authorized to use this procedure.

2.2 **Chain of Custody procedures:** The collector of the sample is responsible for the integrity of the sample until the sample has been properly transferred to the IH Group laboratory using the SHSD established *Chain of Custody IH51300* procedures.

2.3 **Hazard Analysis of the Sampling Task:** It is the responsibility of the person using this method and his/her supervisor to ensure that the appropriate personal protective equipment, as per section 5.2, is worn while performing this procedure. In addition, the person performing this procedure and his/her supervisor are responsible to ensure that all required training and qualification for hazards that may be present in areas where this procedure will be used have been met. The person performing this procedure and his/her line supervisor are responsible to comply with all work planning and work permit system requirements.

## 3.0 Definitions

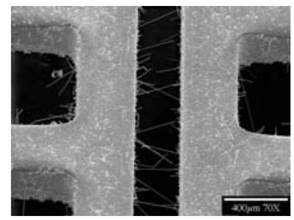
***ACGIH TLV*** means the American Conference of Governmental Industrial Hygienist Threshold Limit Value- a DOE mandated occupational exposure limit.

***Brazing*** (silver soldering or hard soldering) is a joining process whereby a non-ferrous filler metal or alloy is heated to melting temperature **above 800°F (425)°C** and flowed between close-fitting parts by capillary action. At its liquid temperature, the molten filler metal and flux interacts with a thin layer of the base metal, cooling to form an exceptionally strong, sealed joint due to grain structure interaction. Brazing requires a much higher temperature than soft soldering, sometimes over 850 °C. As well as removing existing oxides, rapid oxidation of the metal at the elevated temperatures has to be avoided. This means that fluxes need to be more aggressive and to provide a physical barrier. There are different fluxes available, often using active chemicals such as fluorides, as well as wetting agents. Many of these chemicals are toxic and due care should be taken during their use

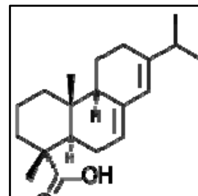
***Flux*** is a substance which facilitates soldering, brazing, and welding by chemically cleaning the metals to be joined. Common fluxes are ammonium chloride or rosin for soldering tin and borax for brazing or braze-welding ferrous metals. The primary purpose of flux is to prevent oxidation of the base and filler materials. Tin-lead solder alone attaches very well to copper, but poorly to the various oxides of copper, which form quickly at soldering temperatures. Flux is a substance which prevents the formation of metal oxides. Flux also allows solder to flow easily on the working piece rather than forming beads.

***Lead-free Electronic Soldering:*** European environmental legislation has specifically targeted lead in the electronics industry. The Directive on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) required many new electronic circuit boards to be lead free by July 1, 2006. Technical challenges of lead free electronic soldering are:

- Traditional lead-free solders have a significantly higher melting point than lead-based solders, which renders them unsuitable for use with heat-sensitive electronic components and their plastic packaging. To overcome this problem, solder alloys with a high silver content and no lead have been developed with a melting point slightly lower than traditional solders.
- Lead-free components, pins, and connectors use copper frames, and either lead, tin, gold or other finishes. Tin finishes are the most popular of lead-free finishes. Nevertheless, this creates a problem of tin-whiskers (a phenomenon whereby the metal grows tiny tin hairs that can cause short circuits and arcing in electrical equipment.) The phenomenon was discovered by telephone companies in the late 1940s and was addressed with the addition of lead to tin solder.



***OSHA PEL*** means the Occupational Safety and Health Administration Permissible Exposure Limit- a DOE mandated occupational exposure limit.



Abietic Acid

***Rosin (colophony)*** is a solid form of resin obtained from pines and some other plants. It is semi-transparent and varies in color from yellow to black. It chiefly consists of different resin acids, especially **abietic acid**. Rosin is the precursor to the flux used in soldering. The lead-tin solder commonly used in electronics has about 1% rosin as a flux core helping the molten metal flow and making a better connection.

***Soldering*** (soft soldering) is the process in which two metals are joined together by a third metal having a relatively low melting point, **below 450°C (842°F)**. The third metal is called solder. Soldering is distinguished from brazing by use of a lower melting-temperature filler metal; it is distinguished from welding since the base metal is not melted during the joining process. In soldering, heat is applied to the parts to be joined, causing the solder to melt and be drawn into the joint by capillary action and to bond to the materials to be joined by wetting action. After the metal cools, the resulting joints are not as strong as the base metal, but have adequate strength, electrical conductivity, and water-tightness for many uses.

***Thermal decomposition*** is a chemical reaction whereby a chemical substance breaks up into at least two chemical substances when heated.

## 4.0 Prerequisites

4.1 **Training prior to using this procedure:**

4.1.1 Demonstration of proper operation of the procedure per Section 7 for qualification requirements.

4.1.2 Training for hazards other than noise may be needed for entry into restricted areas (check with ESH Coordinator or FS Representative for the facility).

4.2 **Area Access**:

4.2.1 Contact the appropriate Facility Support Representative or Technician to obtain approval to enter radiological areas.

4.2.2 Verify with the appropriate Facility Support Representative or Technician if a Work Permit or Radiological Work Permit is needed or is in effect. If so, review and sign the permit.

4.2.3 Use appropriate PPE for area.

## 5.0 Precautions

5.1 **Hazard assessment:** The actual task of taking an air sample typically does not cause significant employee health risks. By its very nature, this SOP may be performed in areas with chemical or radiological contamination, and these hazards must be assessed on a case-by-case basis.

5.2 **Personal Protective Equipment:** No additional personal protective equipment is typically required to protect the person collecting the sample beyond the protection required for the area entered. Disposable gloves may be needed if it is necessary to contact the surfaces around soldering operations. Where the potential for contamination of the body can occur, the use of disposable clothing to cover the areas of contact is required. When the potential for exposure to airborne contaminants above the ACGIH TLV, STEL or Ceiling or OSHA PEL (which ever is lower) may occur, the person collecting the sample must use appropriate respiratory protection in compliance with the BNL Respiratory Protection Program.

5.2.1 **Hand:** Sample collection in areas of known or suspected chemical or radiological contamination requires the use of disposable gloves. Exam-style, splash gloves are acceptable. Acceptable elastomers are: Nitrile, PVC, and Natural Rubber.

5.2.2 **Body:** Lab coats are required when entering laboratories or electronic labs. If contact of the body with contaminated surfaces is anticipated, a disposable suit should be used. Acceptable chemical protective equipment materials include: Tyvek®, KleenGuard®, and cotton. Disposable garments must be discarded as hazardous waste if contact with contamination has occurred. If personal clothing items become contaminated, they must be surrender for BNL cleaning or disposal.

5.2.3 **Foot:** If contact of the footwear is anticipated with contaminated surfaces, disposable shoe coverings, boots or booties should be used. Acceptable CPC material include: Tyvek®, KleenGuard®, and rubber. If personal shoes become contaminated, they must be surrendered for BNL cleaning or disposal.

5.2.4 **Respiratory:** Under normal use, respiratory protection is not required. If chemical or radiological levels from contamination in the area exceed or are likely to exceed the OSHA, ACGIH, or DOE standards, respirators are required. A half face or full face APR or PAPR respirator with appropriate cartridge or an air line respirator may be used up to the assigned protection factor listed in the BNL's Respiratory Protection Selection and Issuance SOPs.

5.2.5 **Eye:** Safety Glasses with side shields are required in laboratories, construction, and general industry areas. When hazardous chemicals can significantly injure the eyes, an increased level of PPE such as goggles or a faceshield are required.

5.3 **Radioactive Contamination:** It is possible that some areas to be entered may have radioactive contamination as well as the soldering residues. In these cases, personal protective equipment and administrative controls must be implemented for the radiological contaminant hazard in addition to the chemical hazard. In addition, the collected sample must be analyzed for the radiological hazard before it can be submitted to the IH Group for analysis. The radiological contamination must be below the permissible release limits to the general public.

5.4 **Work Planning:** All requirements of work permits and work planning system reviews must be met in performing this procedure.

5.5 **Environmental Impact and Waste Disposal:** This technique does not have adverse impact on the environment. The sampling media used in this technique is sent to an offsite laboratory for analysis. No waste is generated at BNL.

5.6 **Job Risk Assessment:** Consult the *Job Risk Assessment* SHSD-JRA-05 for the risk analysis of this operation based on the hazards and controls of this SOP.

## 6.0 Procedure

6.1 **Equipment**

6.1.1 Sampling Pumps: SKC-224-44XR (1-4 l/min), Aircheck® 52 (1-2.5 l/min) and SKC-224-3 (1-250 cc/min), or equivalent.

6.1.2 Collection Media: media and flow rates as per the following table:

| Contaminant | Method, Media, Sampling Rates |
|---|---|
| **Aldehydes Screening:**<br>Formaldehyde; Acetaldehyde; Propionaldehyde; Acrolein; Butraldehyde; Isobutyraldehyde; Crotonaldehyde; Valeraldehyde; Isovaleraldehyde; Hexanal; Heptanal; Furfural | NIOSH 2016<br>Tube: SKC- 226-119 Silica Gel coated with 2,4-Dinitrophenyl hydrazine 150/300 mg<br><br>15 minute sample at 0.2 liters/min for ceiling OEL |
| **Elements** by ICP:<br>Tin & Lead<br>or<br>Metal Screening: Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Copper, Lead, Nickel, Selenium, Silver, Tin, Tungsten, Vanadium, Zinc | NIOSH 7301<br>Filter 0.8Um MCE or Filter 5.0 Um PVC<br><br>At least a 15 minute sample at 2.5 liters/min |
| **Limonene**, pinene, nopinene, isodiprene<br>**&**<br>**Terpenes** by GC-FID: Allyl alcohol; Allyl chloride; n-Amyl acetate; sec-Amyl acetate; Benzyl chloride; Bromoform; Butyl acetate; sec-Butyl acetate; tert-Butyl acetate; Butyl alcohol; sec-Butyl alcohol; tert-Butyl alcohol; n-Butyl glycidyl ether (BGE); p-tert-Butyltoluene; Camphor; Carbon tetrachloride; Chlorobenzene (monochlorobenzene); Chlorobromomethane; Cumene; Cyclohexane; Cyclohexanol; Cyclohexene; Diacetone alcohol (4-hydroxy-4-methyl-2-pentanone); o-Dichlorobenzene; p-Dichlorobenzene; 1,1-Dichloroethane; 1,2-Dichloroethylene; Dichloroethyl ether; 1,1-Dichloro-1-nitroethane; Difluorodibromomethane(F-12-B2); Diisobutyl ketone; Dioxane (diethylene dioxide); Epichlorohydrin; Ethyl acetate; Ethyl sec-amyl ketone (5-methyl-3-heptanone); Ethyl bromide; Ethyl butyl ketone (3-heptanone); Ethylene chlorohydrin; Ethyl ether; Ethyl formate; Glycidol (2,3-epoxy-1-propanol); n-Heptane; Hexachloroethane; n-Hexane; 2-Hexanone (MBK); sec-Hexyl acetate; Isoamyl acetate; Isoamyl alcohol; Isobutyl acetate; Isobutyl alcohol; Isophorone; Isopropyl acetate; Isopropyl ether; Isopropyl glycidyl ether; Mesityl oxide; Methyl acetate; Methylal (dimethoxymethane); Methyl-(n-amyl)ketone; Methylcyclohexane; Methyl isobutyl carbinol; a-Methyl styrene; Octane; Pentane; 2-Pentanone; Phenyl glycidyl ether; n-Propyl acetate; Propyl alcohol; Propylene dichloride; n-Propyl nitrate; 1,1,1,2-Tetrachloro-2, 2-difluoroethane; 1,1,2, 2-Tetrachloro-1, 2-difluoroethane; 1,1,2,2-Tetrachloroethane; Tetrahydrofuran; Tetramethyl succinonitrile; 1,2,3-Trichloropropane; Vinyl toluene. | OSHA 7<br>Tube: Coconut Shell Charcoal<br>SKC-226-01 or SKC-226-09<br><br>At least a 15 minute sample at 0.2 liters/min |

6.2 **Prior to performing air sampling:** Collect information on the soldering/brazing operation, including:

6.2.1 Identify the materials in use:

6.2.1.1 Manufacturer Brand & name of solder metal (determine the lead and other metal content)

6.2.1.2 Manufacturer Brand & name of flux (determine if acid or rosin based),

6.2.1.3 Manufacturer Brand and Model number of soldering tool (iron or torch)

6.2.2 Record the engineering controls being used- local capture system (Brand and model), dilution ventilation, fans, etc.

6.2.3 Record the Personal Protective Equipment and Administrative Controls being used- lab coat, uniform, gloves, respirator, etc.

6.2.4 Review the Work Planning documentation for inclusion of appropriate controls.

6.2.5 Observe the housekeeping and cleanliness of the area; observe the safety of combustible and flammable materials in the area. Recommend/ initiate any immediate corrective actions

6.3 Measure the **airborne levels of rosin/acid flux thermal decomposition products**. At a minimum, measure Aldehydes (**Aldehydes** Screening: NIOSH 2539) and **Terpenes** (NIOSH 1552). Make sure the full 8-hour shift is accounted for with monitoring or a work history (See IH60500).

6.4 Measure the **airborne levels of metal fumes** in the area from **brazing operations**. Make sure the full 8-hour shift is accounted for with monitoring or a work history. (See IH60500.).

(Note: During the ISM Corrective Action validation of the current SBMS *Lead* Subject Area requirements for *Electronic Soldering Operations*, take airborne METALS measurements for each **electronic solder** component - analyze for all metals in the base solder and lead if the soldering is re-work on lead solder or unknown components.)

**Sampling Technique:** Determining HOW MANY samples to take: It is not possible to provide definitive guidance on the number of samples to be taken in every case. Use professional judgment in determining the number of samples. Factors that should be considered in selecting the number of replicate samples to be taken include: number of workers in the area, the size of the area to be tested, and the predicted uniformity of contamination over the face area.

**Sampling Technique:** Determining WHERE to take samples should focus on:

- the breathing zone of the person performing the soldering and brazing,
- a sample close to the point of soldering/brazing- preferably just downwind in the fume plume,
- areas where other workers predominately spend time or frequently access,
- areas where contamination is not expected (serves as a control), and
- areas where contamination would not be permissible (such as lunch rooms and offices).

6.5 For each type of sample, include at least 1 un-exposed media with each set of samples (provide 1 blank per 6 samples). If more than six (6) samples are to be taken, it is suggested that at least one (1) duplicate sample be taken in close proximity to one other to verify the precision (repeatability) of the sampling.

6.6 Measure the **surface levels of metals** in the area from brazing & soldering operations using IH75190.

6.7 **Reporting results**: Report personal sample results in accordance with IH60500. The assessment of results of airborne & surface wipe sampling should be conveyed to the requestor of the sampling, that organization's ESH Coordinator and the management of the building's occupants in the form of a written analysis documenting:

6.7.1 Sampling and analysis methods,

6.7.2 Contamination levels measured,

6.7.3 Impact of the levels on regulatory compliance and occupant safety including a comparison to Occupational Exposure limits (ACGIH TLV and OSHA PEL), and

6.7.4 Recommendations on corrective actions (if corrective action is necessary).

## 7.0 Implementation and Training

7.1 **Qualification Criteria:** Use of this SOP shall be limited to persons who have demonstrated the competency to satisfactorily use the procedure, as evidenced by experience and training, to the satisfaction of the SHSD IH Program Manager. All persons must have met the qualification criteria for IH75C Surface Wipe Sampler and IH75D Airborne Chemical Sampler sets in *IH50300 BNL IH Program and IH Group Training & Qualification Matrix.*

7.2 Personnel are to document their training using Attachment 9.2, the Job Performance Measure Completion Certificate. Qualification on this JPM is required on a 3 year basis, providing they meet the requirements of IH50300 and submit appropriate Annual Skill Qualification Forms.

## 8.0 References

8.1 OSHA Technical Manual

8.2 United Kingdom, Health and Safety Executive MDHS 83/2: *Methods for the Determination of Hazardous Substances: Resin acids in rosin (colophony) solder flux fume*, 08/06.

8.3 US Department of Labor, OSHA, Salt Lake City Laboratory: Chemical Sampling Information- Abietic Acid, 10/20/06.

8.4 SKC Guide to HSE 83/2 Air Sampling Methods: Colophony; Abietic Acid

8.5 SKC: Formaldehyde Sample Tube Publication 1049, Rev 0404.

8.6 SKC: Sorbent Sample Tube Catalog 226-119 Operating Instructions, Form #37575 Rev 0703.

8.7 NIOSH Manual of Analytical Method, Fourth Edition, Method 2538 (Acetaldehyde by GC); 2539 (Aldehydes, Screening); 2016 (Formaldehyde); 2018 (Aliphatic Aldehydes), and 1552 (Terpenes).


## 9.0 <u>Attachments</u>

9.1 OSHA Technical Manual (excerpt on Soldering and Brazing)

9.2 Short Guide to Soldering/Brazing Evaluations

9.3 Job Performance Measure (JPM) Completion Certificate

9.4 Qualification Exam

## 10.0 Documentation

| Document Development and Revision Control Tracking | | |
|---|---|---|
| Prepared By:<br><br>*Signature and date on file*<br>R. Selvey, CIH 09/05/07 | Technical Reviewed By / Date:<br><br>*Signature on file*<br>J. Peters, CIH, CSP 09/07/07 | SHSD Approved By / Date:<br><br>*Signature on file*<br>R. Selvey 09/18/07 |
| ESH Coordinator/ Date:<br>*none* | Work Coordinator/ Date:<br>*none* | SHSD Manager / Date<br>*none* |
| QA Review /Date:<br>*none* | Training Coordinator / Date:<br>*none* | Filing Code:<br>**IH52** |
| RCD Facility Support Approved By/ Date:<br>*none* | Environ. Compliance Rep. / Date:<br>*none* | Effective Date:<br>**09/18/2007** |
| ISM Review - Hazard Categorization<br>☐ High<br>☒ Moderate<br>☐ Low/Skill of the craft | Validation:<br>☐ Formal Walkthrough<br>☐ Desk Top Review<br>☐ SME Review<br>Name / Date: | Implementation:<br>Training Completed: Tracked in BTMS<br>Procedure posted on Web: 09/18/07<br>Hard Copy files updated: 09/18/07<br>Document Control: 09/18/07 |

| Revision Log | | |
|---|---|---|
| Purpose: ☐ Temporary Change ☐ Change in Scope ☐ Periodic review ☐ Clarify/enhance procedural controls<br><br>Changed resulting from: ☐ Environmental impacts ☐ Federal, State and/or Local requirements ☐ Corrective/preventive actions to non-conformances ☐ none of the above<br><br>Section/page and Description of change: | | |
| *(Signature on File)*<br>SME Reviewer/Date: | Reviewer/Date: | Reviewer/Date: |

## Attachment 9.1

## OSHA Technical Manual

**SECTION V: CHAPTER 3**

**CONTROLLING LEAD EXPOSURES IN THE CONSTRUCTION INDUSTRY: ENGINEERING AND WORK PRACTICE CONTROLS**

**Contents:**



Note: Text coloring and *Italics* added for emphasis.

A. **SOLDERING AND BRAZING.**

1. Soldering and brazing are techniques that are used to join metal pieces or parts. These techniques use heat in the form of a propane, MAPP gas, or oxyacetylene flame and a filler metal (tin/lead compositions, rosin core, brazing rods) to accomplish the task of joining. This activity is usually performed by workers in the plumbing trades. The potential exposure source is the filler metal that contains lead.

2. Soldering and brazing operations present similar health hazards (airborne lead fumes) but to a different degree. *Most soldering operations occur at temperatures that are less than 800°F. The melting point of the filler metals is usually quite low (<600°F) and the activity does not generate significant concentrations of metal fumes. Brazing operations usually occur at temperatures in excess of 800°F. The temperature of the operation is of major importance because temperature determines the vapor pressure of the metals that are heated and therefore the potential concentration of metal fumes to which the employee may be exposed.*

3. Because most field soldering and brazing work is conducted with a torch, it is difficult to regulate operating temperatures to within recommended limits to reduce the amount of metal fumes generated. *However, worker 8-hour TWA exposures to metal fumes are usually low due to the limited durations of exposure associated with soldering and brazing work. Electricians soldering electrical connections, plumbers soldering nonpotable water lines, or roofers repairing tin flashing could all experience these short-term and intermittent lead exposures.*

4. **Engineering Controls**. In confined areas, portable local exhaust ventilation can be used to remove metal fumes and gases associated with this type of work.

# Short Guide to Soldering/Brazing Evaluations

Note: This form can be printed as used as an Attachment to the Airborne Sampling form.

| | |
|---|---|
| **Date:** | |
| **Location:** | |

**Sample**
See SHSD SOP web page for most recent version

| Concern/ Required Information | Action, Observation, Status |
|---|---|
| **SOLDER METAL** (Manufacturer Brand & name; determine the lead and other metal content) | |
| **FLUX** (Manufacturer Brand & name; determine if acid or rosin based) | |
| **SOLDERING TOOL** (Manufacturer Brand and Model number of iron or torch) | |
| **ENGINEERING CONTR** (Brand and model), dilutic | |
| **PERSONAL PROTECTIVE EQUIPMENT ADMINISTRATIVE CONTROLS** being used | ☐ Safety Glasses ☐ Goggles<br>☐ Face Shield<br>☐ Lab coat ☐ Uniform<br>☐ Long Sleeves Shirt<br>☐ Gloves Type:<br>☐ Respirator<br>☐ Other: |
| Review the **WORK PLANNING** documentation for inclusion of appropriate controls. | ☐ Adequate ☐ Not Applicable<br>☐ Not Addressed |
| **HOUSEKEEPING** and cleanliness of the area; observe the safety of combustible and flammable materials in the area. | |
| **AIRBORNE LEVELS OF ROSIN/ACID FLUX** thermal decomposition products. At a minimum, Aldehydes Screening: and Terpenes. Account for the full 8-hour shift with monitoring or a work history. | ☐ Sampled ☐ Not Applicable |
| **AIRBORNE LEVELS OF METAL FUMES** in the area from brazing operations. Account for the full 8-hour shift with monitoring or a work history. | ☐ Sampled ☐ Not Applicable |
| Sample locations:- breathing zone | ☐ Sampled ☐ Not Applicable |
| - close to the point of soldering/brazing | ☐ Sampled ☐ Not Applicable |
| - areas where other workers predominately spend time or access | ☐ Sampled ☐ Not Applicable |
| - areas where contamination is not expected (control) | ☐ Sampled ☐ Not Applicable |
| - areas where contamination not permissible (lunch rooms & offices) | ☐ Sampled ☐ Not Applicable |
| **SURFACE LEVELS OF METALS** in the area | ☐ Sampled ☐ Not Applicable |

# Soldering Operations – Hazard Evaluator
## Job Performance Measure (JPM) Completion Certificate

| Candidate's Name | Life Number: |
|---|---|
| | |

**Practical Skill Evaluation: Demonstration of Evaluation Methodology by Oral Exam**

| Criteria | Qualifying Performance Standard | Unsat. | Recov. | Satisf. |
|---|---|---|---|---|
| **1. Hazard Analysis** | Understands the hazards of the soldering operation and the need to perform a hazard analysis of the area and potential exposure to the self as sampler and workers in the area. | | | |
| **2. Personal Protective Equipment** | Understands the need to be aware of the potential surface contamination, airborne levels of contaminants, radiological hazards, and noise hazard. Knows how to determine the need for PPE. | | | |
| **3. Sampling Equipment** | Knows where equipment needed for the procedure is located and how to properly sign it out. | | | |
| **4. Pre-Testing Inspection** | Verifies the system to be monitored is operational and represents typical operation. Makes notation in sampling record if the operating conditions are atypical. | | | |
| **5. Conducts appropriate interviews** | Demonstrates knowledge in stepping up and conducting monitoring with input from supervision and workers to determine exposure characteristics. | | | |
| **6. Identification of hazards to be measured** | Describes the type of airborne and surface hazards to be sampled. Identifies the work control practices that should be in place- such as PPE and ventilation. | | | |
| **7. Measurement of hazard** | Knows how to properly measure employee exposure to hazardous levels of rosin thermal decomposition products and metal fumes. | | | |
| **8. Documentation** | Demonstrates correctly filling out IH forms, transfers appropriate info to IH databases, prepares an evaluation assessment report (including an evaluation of the relationship of the exposure to occupational exposure limits), and notify workers and management of the results. | | | |

I accept the responsibility for performing this task as demonstrated within this JPM and the corresponding SOP.

| Candidate Signature: | Date: |
|---|---|
| | |

I certify the candidate has satisfactorily performed each of the above listed steps and is capable of performing the task unsupervised.

| Evaluator Signature: | Date: |
|---|---|
| | |

# Soldering Operations Evaluations – Exam

| Candidate's Name | Life Number: |
|---|---|
| | |

**1. List four organic/inorganic compounds that might the present in the air from soldering rosin based flux material (colophony)?**

a.

b.

c.

d.

**2. What metals are commonly used in soldering** (List the Common Name, the Elemental 2 Letter Code, and whether it is very hazardous under the concentrations found in soldering (both airborne or handling the metals)

| | Chemical Name | Element | Hazardous to health |
|---|---|---|---|
| a. | | | ☐ |
| b. | | | ☐ |
| c. | | | ☐ |
| d. | | | ☐ |
| e. | | | ☐ |

**3. List four steps in conducting a high quality assessment of exposure risk from a soldering operation**

a.

b.

c.

d.